Missouri River Basin Aquatic GAP Project

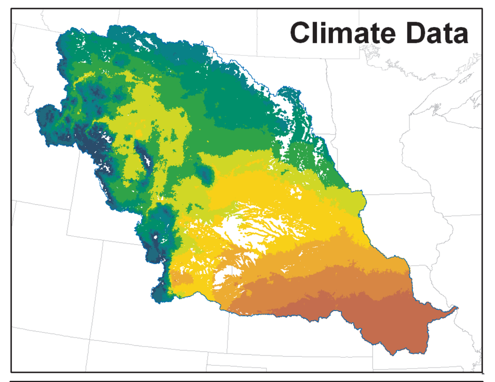
1. Classification Hierarchy

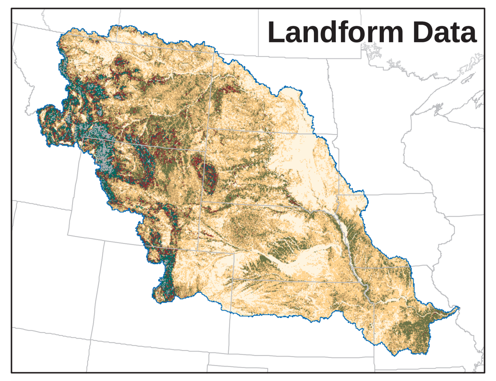
Our objective was to identify and map riverine ecosystems that are relatively distinct with regard to ecosystem structure, function, and evolutionary history at multiple levels. To accomplish this, a multi-level classification hierarchy was developed. Levels within the hierarchy were either empirically delineated using biological data or delineated in a top-down fashion using landscape and stream features (e.g., drainage boundaries, geology, soils, landform, stream size, gradient, etc.) that have consistently been shown to be associated with or ultimately control structural, functional, and compositional variation in riverine ecosystems.

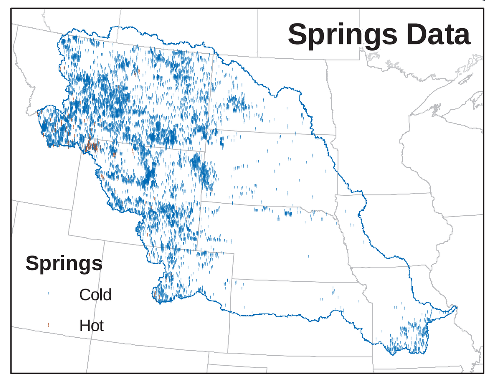
Classification Hierarchy Definitions

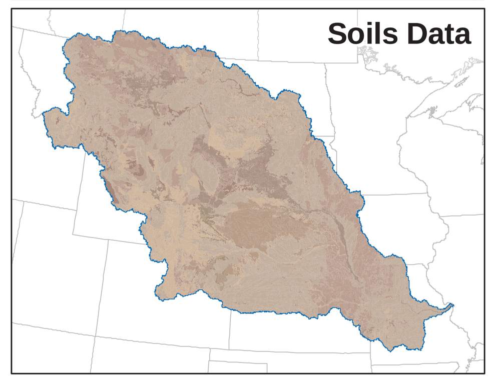
- Aquatic Subregions account for differences in the ecological composition of riverine assemblages resulting from geographic variation in ecosystem structure and function.
- Ecological Drainage Units (EDU) stratify Aquatic Subregions into relatively distinct zoogeographic subunits that also fit the definition of an ecosystem.
- Aquatic Ecological System Types (AES-Types) represent hydrologic units with relatively distinct combinations of geology, soils, landform, and groundwater influence.
- Valley Segment Types (VSTs) represent hydrogeomorphic stream units defined by local physical factors and their position in the stream network.

Examples of Input Variables

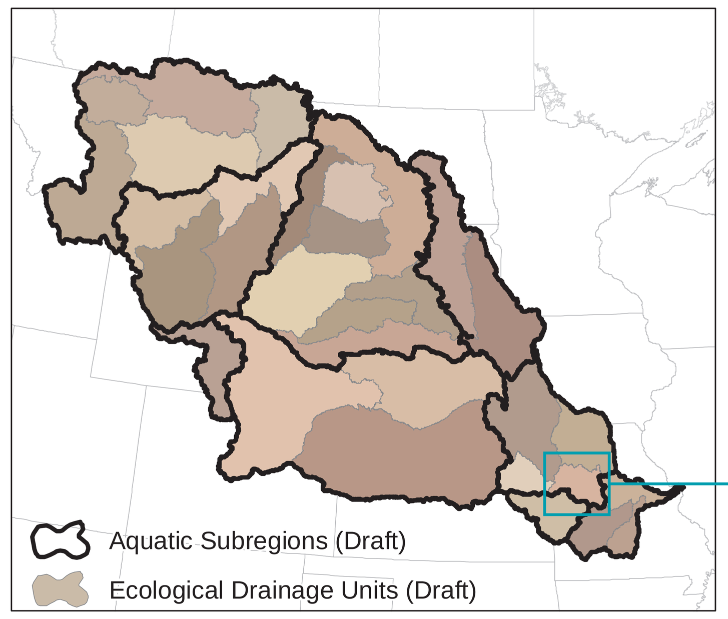




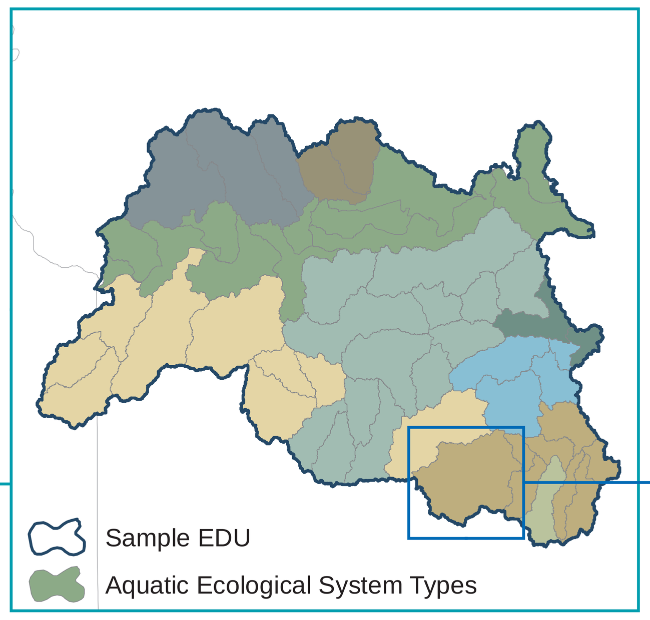




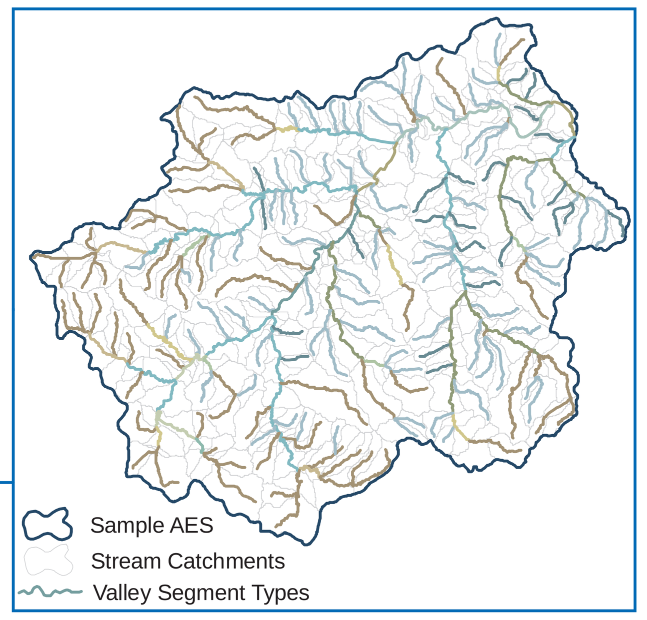
Aquatic Subregions and Ecological Drainage Units



Aquatic Ecological Systems

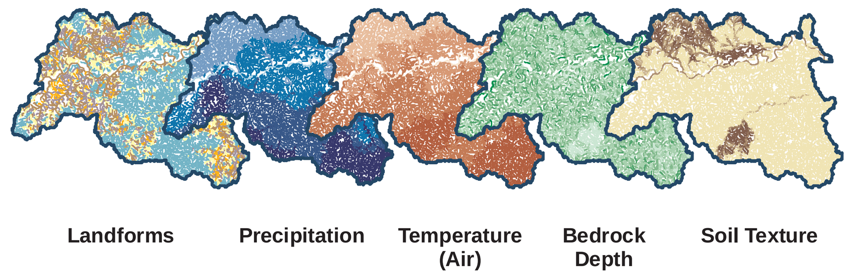


Stream Valley Segment Types

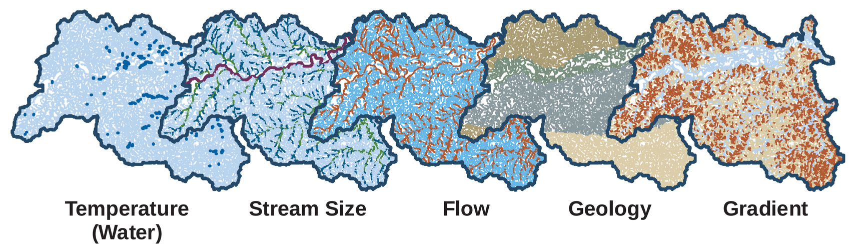


2. Species Modeling

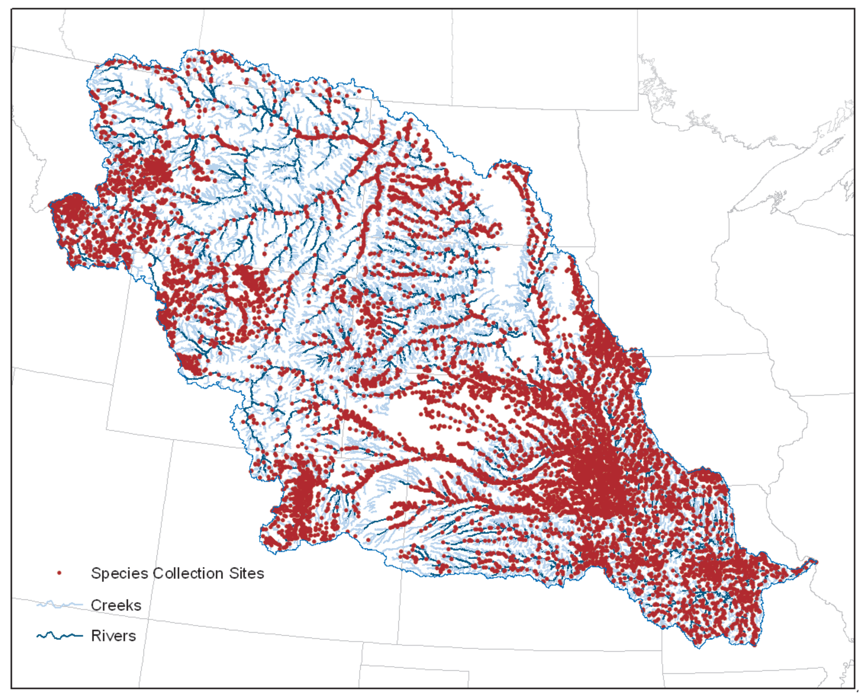
Examples of Watershed Variables



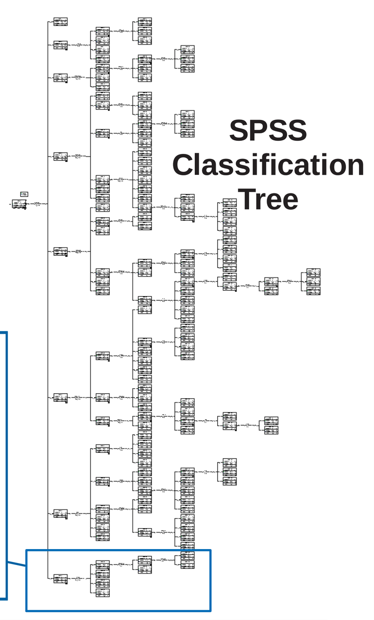
Examples of Local Variables



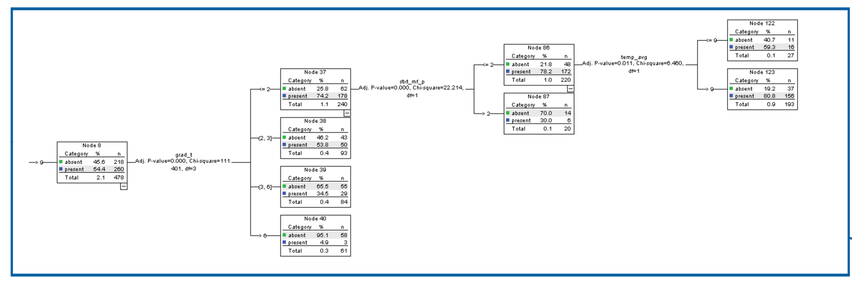
Collection Sites

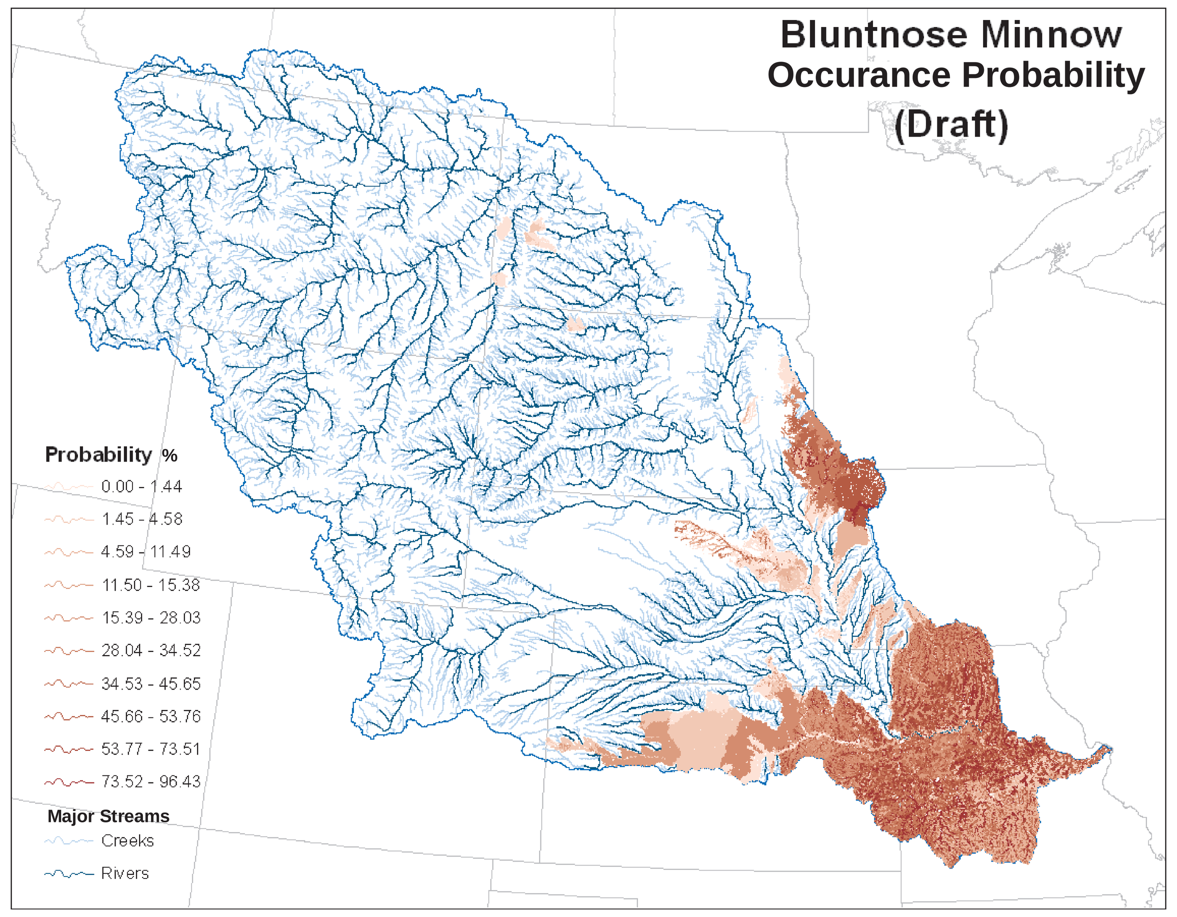


Species sampling data including collection site stream segment IDs, was combined with stream habitat attributes. A set of collection and habitat variables was entered into SPSS and analyzed using the exhaustive CHAID methodology in Classification Tree. The resulting distribution model is shown as a tree diagram. All attribute data leading to an end node in the tree is used in a query to select matching stream segments. The model includes the probability of finding the species in a chosen stream segment.

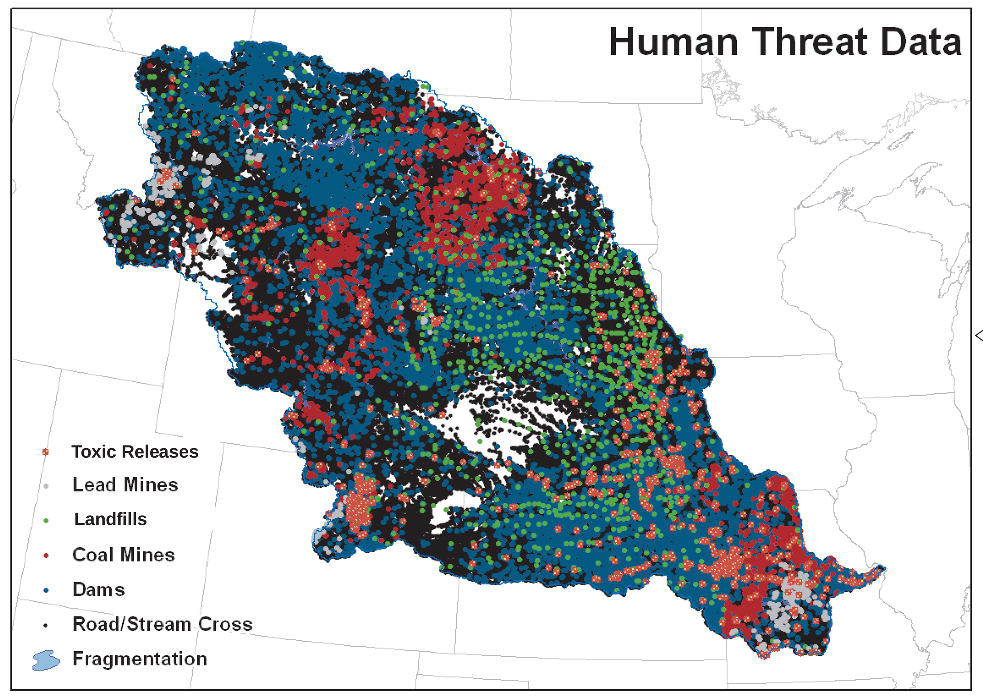


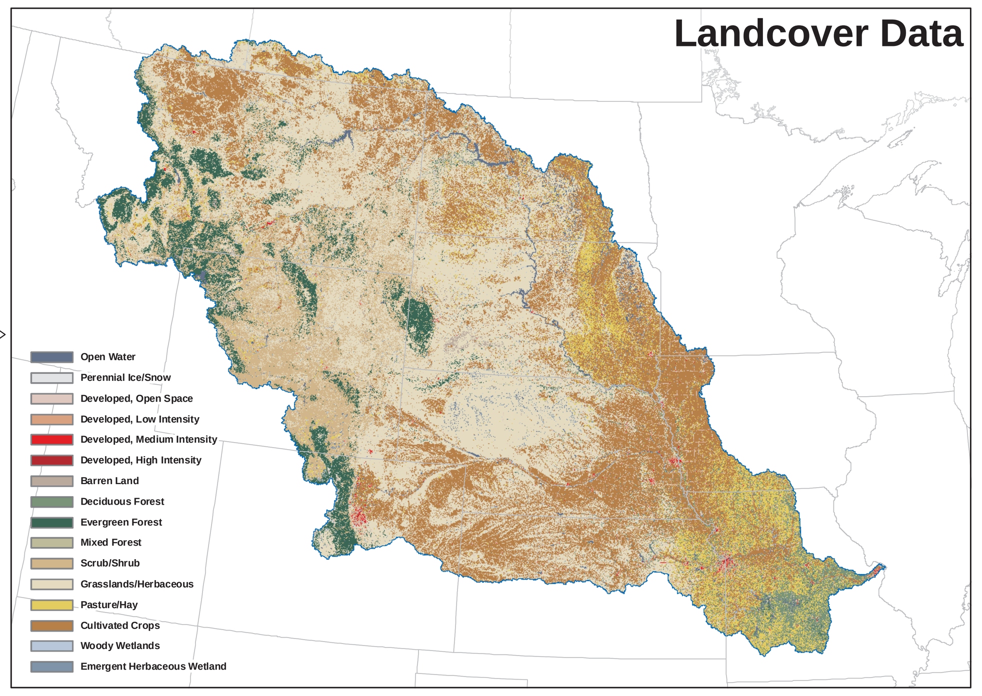
Inset of Classification Tree Model



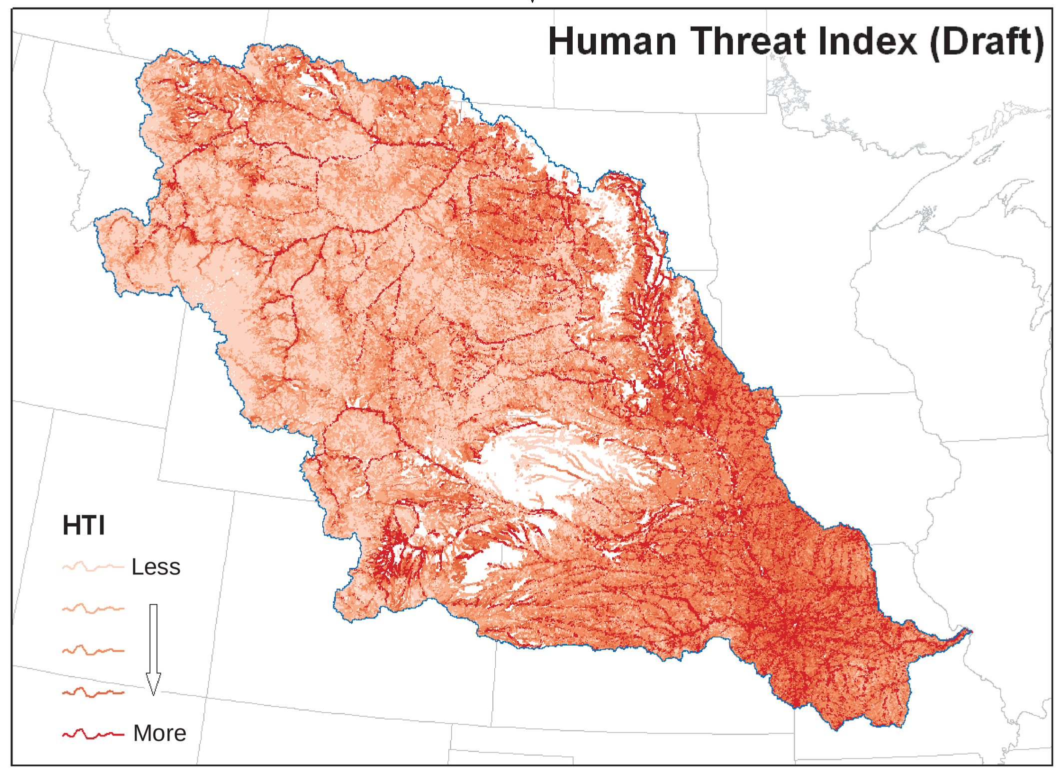


3. Human Disturbances





Working in consultation with a team of aquatic resource professionals, we generated a list of the principal human activities known to negatively affect the ecological integrity of streams. We then assembled the best available (i.e., highest resolution and most recent) geospatial data that could be found for each of these threats. Next, we generated statistics on the individual human threats (e.g., percent urban, lead mine density, degree of fragmentation) for each of the stream reach watersheds in the Missouri River Basin. We then used correlation analysis to reduce this overall set of metrics into a final set of 11, relatively uncorrelated, measures of human disturbance. Relativized rankings (range 1 to 4) were then developed for each of the 11 metrics. The relativized rankings for each of these 11 metrics were then combined into a Human Threat Index (HTI).



List of Human Threats

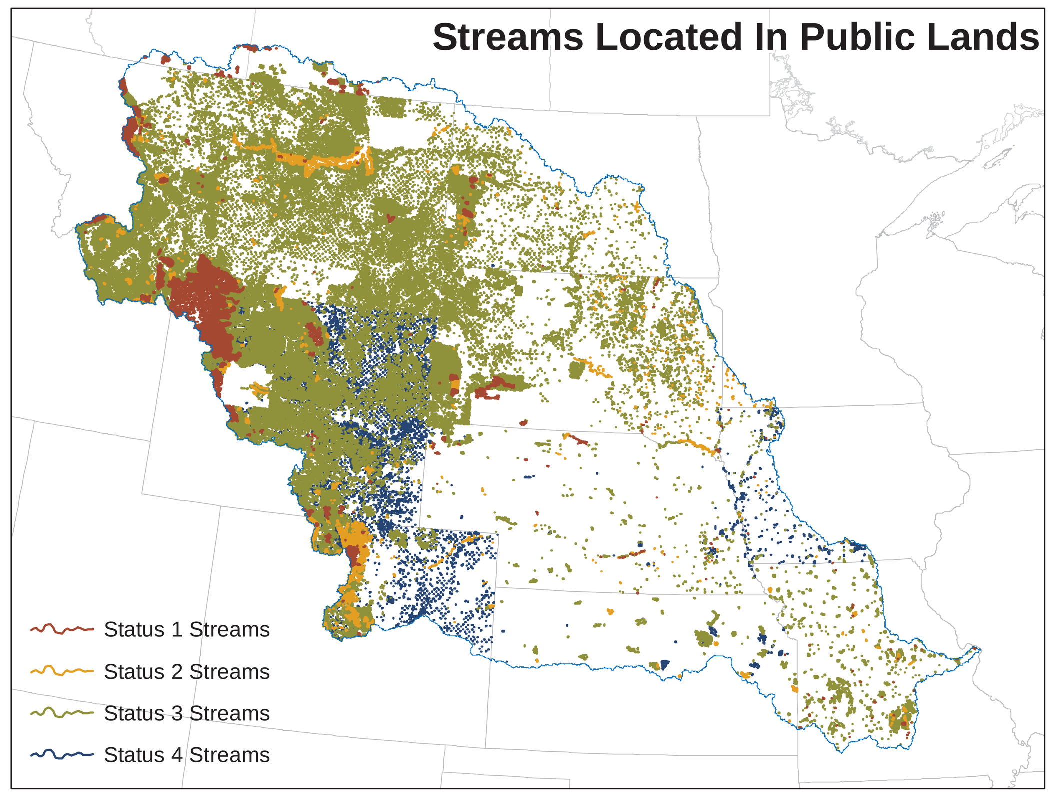
- Impervious Surface
- Introduced Species
- Percent Agriculture
- Road/Stream Crossings
- Dams
- Coal mines
- Lead Mines
- Population Change
- Fragmentation
- Discharge Sites
- Confined Animal Operations

4. GAP Analysis

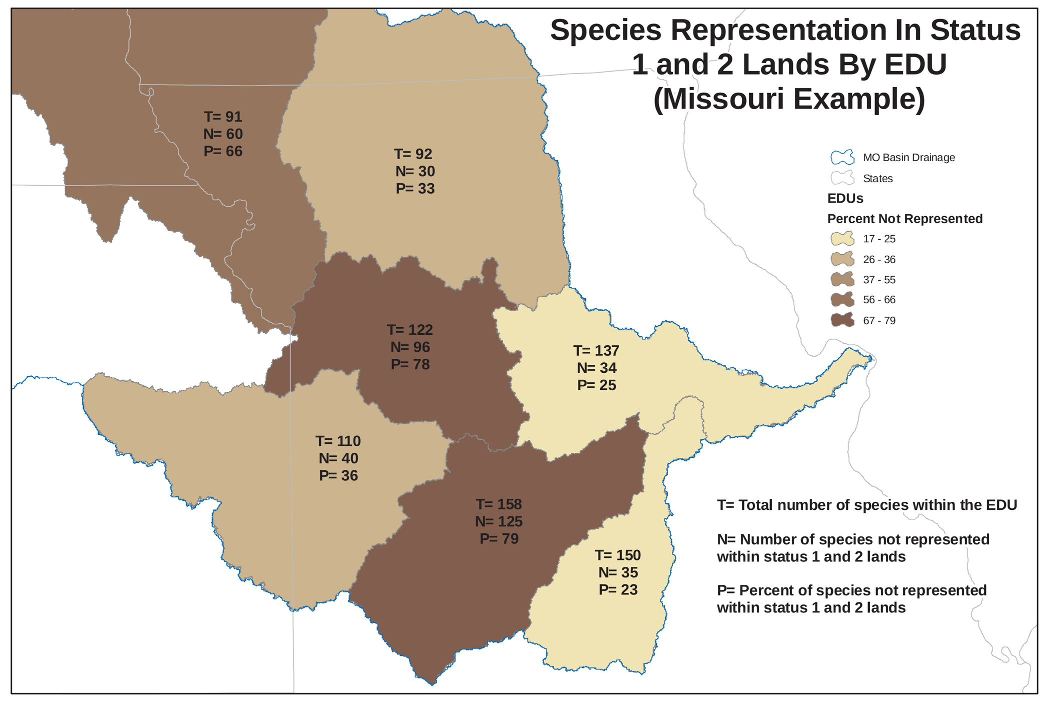
Once the classification hierarchy, species modeling and human disturbances are completed all of the elements for conducting a Gap Analysis will be in place. The goal of a GAP Analysis is to identify riverine ecosystems and species not adequately represented (i.e., gaps) in the matrix of conservation lands in the Missouri Basin. In addition, it can provide spatially explicit data that could be used by natural resource professionals, legislators, and the public to make more informed decisions for prioritizing opportunities to fill these conservation gaps and to devise strategic approaches for developing effective long-term biodiversity conservation plans.

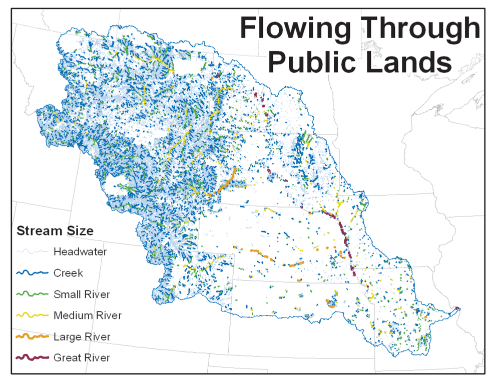
Conservation Status Statistics For Streams in the Missouri River Basin

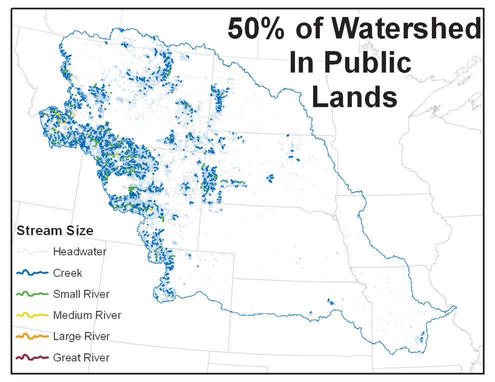
Stream Size	Total Length (km)	Length in Status 1 or 2	Percent in Status 1 or 2
Headwater	787,632.8	18,650.3	2.36
Creek	143,762.5	2680.7	1.86
Small River	51,005.0	820.7	1.60
Medium River	18,128.4	258.9	1.42
Large River	4297.4	21.7	0.50
Great River	2532.0	342.3	13.51



One of the primary objectives of GAP is to provide information on the distribution and status of several elements of biological diversity. This can be accomplished by first producing maps of riverine ecosystem units at multiple scales (see Section 1), predicted fish distributions (see Section 2), and land stewardship and management status (see Section 4). By intersecting the land stewardship and management data with the classification hierarchy and the predicted fish distributions, watershed statistics can be derived for each of the different land stewardship and management categories.







References

Booth, D. B. and C. R. Jackson. 1997. Urbanization of aquatic systems: degradation thresholds, stormwater detection, and the limits of mitigation. Journal of the American Water Resources Association 33: 1077-1089.

Richter, B.D, D.P. Braun, M.A. Mendelson, and L.L. Master. 1997. Threats to imperiled freshwater fauna. Conservation Biology 11: 1081-1093.

Sowa, S. P., G. Annis, M. E. Morey, and D. D. Diamond. 2007. A gap analysis and comprehensive conservation strategy for riverine ecosystems of Missouri. Ecological Monographs 77(3): 301-334.

Sowa, S. P., G. Annis, M. E. Morey, and A. Garringer. July 2006. Developing predicted distribution models for fish species in Nebraska. Final report submitted to the USGS National Gap Analysis Program. Moscow, ID. 489 pp.

Map by Aaron J. Garringer, Michael E. Morey and Gust M. Annis
Missouri Resource Assessment Partnership
University of Missouri - Columbia
January 2009

Missouri River Basin GAP
MoRAP Map Series
MS-2009-001